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ABSTRACT

Two studies (1) investigated memory strategies in subjects with different levels of classification skills, and (2) examined the role of early classification skills in memory. Subjects in Study 1 were 60 (kindergarten and first-grade) children. Classification skills were assessed by a pretest. Subjects were assigned to one of two conditions, free recall or cued recall, then were individually shown slides representing familiar categories and items and were asked to recall as many as possible. When subjects in the free recall finished, a second presentation began. When subjects in the cued recall finished, category cues were provided in the form of four questions. This procedure was repeated three times with each child. A repeated measures analysis of variance found three main effects significant (classifier type, recall condition, trials). Two groups of children were distinguished from the results: (1) those who could both generate and profit from a strategy; and (2) those who could profit from a strategy but were unable to generate it. In the second study, 93 preschool children were pretested on classification skills with a sort-resort task, and then given a shortened memory task. Results indicate that the main effect of classification skill was not significant, but that the main effect of the recall situation was significant. Both studies suggest that operations of class inclusion and hierarchical classification are at least correlated with the transition to efficient use of organization skills in memory. (Author/SB)

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Organization Facilitates Memory--
If You Have the Appropriate Classification Skills

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The information processing abilities of adults have long been a subject of interesting and provocative investigations. Increasingly these adult studies have focused on how subjects organize their information for efficient storage. Indeed Bower (1970) and Cohen (1966) have suggested that cognitive organization is a central factor in storage and retrieval. Ornstein, Trabasso, and Johnson-Laird (1974) are even more adamant. After presenting a memory task to undergraduates, they conclude that "to organize is to a considerable extent, to remember" (pg. 1017). The question of interest to a developmental psychologist is, how does this organizational ability, which seems so essential to recall, develop? Developmental studies of memory strategies have typically found that younger children are not as effective at most recall strategies as older children. However, the possible mechanisms for this finding remain obscure. Neimark, Slotnick, and Ulrich (1971) have noted that the acquisition of memory strategies parallels Piagetian stages of cognitive development "with respect to component activities and ages of transition" (pg. 431). Based on this correspondence, they suggest that the developmental differences in memory strategies reflect the extent to which a child is actively processing, transforming and restructuring information.

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One of the central changes in cognitive development which might facilitate a child's attempts to transform and restructure information is the acquisition of classification skills. Kofsky (1966) has outlined exhaustively the series of skills which a child acquires as he progresses from (a) sorting objects into one and only one category to (b) being able to sort and resort the same objects into multiple categories to (c) the notion of class inclusion--objects can belong to one class and yet simultaneously belong to a second, superordinate class.

The central question of the present investigations was whether the acquisition of this set of classification skills would correspond to the ability to use organizational skills effectively in a memory task. Children with varying degrees of classification ability were asked to recall a list of familiar items. It was expected that with age held constant, subjects with classification skills would demonstrate better recall and more organization in their recall than subjects without classification skills. A second feature of an adult's organizational skills is an ability to use cues to assist recall. Bower and his colleagues have shown that adults recall an item list very efficiently if they are given organizational categories or cues. Without these cues, recall of a list is extremely limited on the first trial but improves dramatically on succeeding trials (Bower, Clark, Winzenz and Lesgold, 1969). One interpretation of these results is that adults not provided with organizational cues are gradually imposing their own organization on the material. Can children use cues similarly to

aid recall? The present studies attempted to evaluate the effectiveness of cues by having the children recall in either a free or a cued setting.

In summary then, the purpose of the present study was to investigate memory strategies in subjects with different levels of classification skills. To do this the age of the subjects was held constant and the independent variables were the operational skill of the subjects and whether or not their recall was aided by a cueing procedure.

Study I

Subjects

Sixty children (30 classifiers and 30 nonclassifiers) were selected from 89 kindergarten and first grade children. The sample population was from a lower middle class, white residential area. The classifiers and nonclassifiers were not significantly different in terms of age ($\bar{X}$ = 77.5 and 76.3 months, respectively).

Classification Pretest

Classification skills were assessed individually by administering a pretest consisting of three class inclusion items from Kofsky (1966) and three hierarchical classification tasks from Ahr and Youniss (1970). Subjects were first presented with two blue triangles, four blue squares, and three red triangles. They were then asked whether there were (a) more blues or squares, (b) more reds or triangles, and (c) more triangles or blues. The final three tasks were taken from Ahr and Youniss (1970). In

their tasks, cats and dogs must be included in the superordinate category animals. The subjects were first presented with six cats and two dogs and asked "Are there more animals or more cats?". The second task presented three cats and five dogs. Subjects were asked "Are there more animals or more dogs?". Finally, eight cats alone were presented, and subjects were asked "Are there more cats or more animals?".

The six tasks were scored either 1, for a correct response, or 0. To be considered correct, subjects had to give the appropriate response plus an explanation which indicated that they were counting subclasses and reclassifying or organizing those subclasses. Subjects who got 4 or more tasks correct were placed in the classifier group. Subjects receiving a total score of 0 or 1 were assigned to the nonclassifier group. Children with intermediate scores of 2 and 3 were not included ($n = 29$). The 30 classifiers and the 30 nonclassifiers were then randomly assigned to either a free recall condition or a cued recall condition for the experimental procedure. An analysis of the final experimental groups showed that the boys and girls were approximately equally distributed among the four cells ($X^2 = 1.07$, $df = 1$, $p > .10$). The kindergarten subjects were split exactly between the classifier and nonclassifier groups.

Memory task

The pretest was administered to all subjects before the memory phase of the experiment was initiated. The time period between the pretest and the memory task was approximately two weeks for all

subjects. Three experimenters assisted in the pretesting whereas the memory phase of the experiment was conducted solely by the third author.

For the memory task, twenty slides representing categories and items familiar to children were made from pictures in the Columbia Mental Maturity Test (1972) and the Peabody Picture Vocabulary Test (1965). The categories included animals, furniture, clothing, and parts of the body. The order of stimulus presentation for all three trials was as follows: duck, bed, mitten, chicken, ear, shoe, foot, lips, pig, cat, chair, eye, dresser, cow, hand, jacket, table, sock, couch, necklace.

Subjects were seen individually and instructed to name each picture as it was presented. This labeling was designed to assure a maximum amount of attention to the stimulus during its 4 second presentation and to facilitate discovery of the categories (Milgram, 1968). In addition, the subjects were told that they would be asked to recall the pictures and that they would be shown the pictures three times. To assure understanding, each subject was asked to repeat the instructions and clarifications were made if necessary.

Immediately after the first presentation of the 20 slides, subjects were asked to recall as many pictures as possible. When subjects in the free recall condition indicated that they were finished, the second presentation began. When subjects in the cued recall group indicated that they were finished, the category cues were provided in the form of four questions. After

each of the three presentations, these subjects were asked "Can you remember any more of the animals that you saw?", etc. Following a third presentation and recall, subjects were asked several questions about the experiment and returned to the classroom. All of the subjects' responses were tape recorded and transcribed later.

Two dependent measures were obtained on recall prior to cueing. First, the number of stimuli recalled on each presentation was totaled. Second, an index of the amount of category clustering was obtained for each presentation. To keep the cued and free recall conditions as similar as possible, both measures excluded any additional responses that the cued group gave after the categories were supplied. The item clustering index used was a ratio of the amount of clustering observed (the number of same category items occurring consecutively relative to an index of the amount that could be observed, Robinson, 1966).

Results

A 2 (classifier type) by 2 (recall condition) by 3 (trials) repeated measures analysis of variance of the item clustering index indicated that all three main effects were significant. The classifiers clustered items significantly more than the non-classifiers $F(1,56) = 7.313$, $p < .01$. The cued recall group clustered significantly more than the free recall group $F(1,56) = 6.345$, $p < .02$; and clustering increased across trials $F(2,112) = 3.692$, $p < .03$. There were no significant interactions.

A further analysis of the means showed that by the third trial classifiers in the free recall group clustered significantly

more than nonclassifiers in the free recall setting (Neuman-Keuls, $p < .01$). It is clear from these results that nonclassifiers when they are not provided with cues are not spontaneously clustering. A comparison of their performance with the nonclassifiers who are provided with cues provides compelling evidence for the usefulness of cues in organizing information, even among nonclassifiers.

It was predicted that the nonclassifiers would be able to efficiently organize the stimuli if they were given the category cues. Their recall, then, should look very much like that of classifiers. That this was the case is demonstrated in Figure 1. The item clustering index of the nonclassifiers in the cued group did not differ from the two classifier groups on any of the trials. All three of these groups showed significantly more clustering on the final two trials than the nonclassifiers who were not given the category cues (Newman-Keuls, $p < .02$).

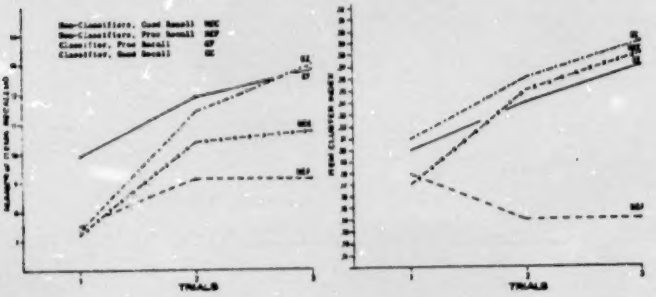

Figure 1

Item clustering index and total number recalled for all groups

A somewhat different pattern of results is reflected in the number of items recalled over trials (see Figure 1). As expected the classifiers recalled significantly more items than the nonclassifiers $F(1,56)=13.35$, $p<.001$. The main effect of recall condition was, however, not significant. It appears that the classifiers are able to cluster the items and this clustering is an effective aid to memory. However, the nonclassifiers provided with cues do not differ from the nonclassifiers in the free recall setting in the number of items they recall. Hence, the increased organization which we see in the nonclassifiers' recall when they are provided with cues does not serve as an effective aid to remembering more items.

Discussion

The results of the present study seem to be consistent with the continuum which has been suggested by Flavell (1970) for the acquisition of recall strategies. He suggested that children can use strategies that are provided for them before they can generate that strategy on their own. It should thus be possible to discriminate at least three groups of children: (a) those who can both generate and profit from a particular strategy, (b) those who can profit from the strategy but are not able to generate it, and (c) those who can neither generate nor profit from the strategy. The classifiers in Study I were able to generate and use categories to increase their recall. As shown by the clustering analysis, the nonclassifiers were not able to generate the categories but could clearly use category cues to aid in

clustering. The data from Study I only speak to these two points on the continuum. However, one can speculate about the classification skills of a child who can neither generate nor profit from categories. To do this, one must remember that the nonclassifiers in the present study were selected because they did not evidence class inclusion or hierarchical classification abilities. These skills, however, represent the most sophisticated of a whole array of classification skills that begin during the preschool years with grouping of stimuli (Kofsky, 1966). It is entirely possible that children at earlier stages of classification could neither generate nor profit from categories even if they were supplied. Study II examinated the role of these early classification skills in memory.

Study II

Preschool children whose abilities at some of the more elementary classification skills varied were asked to remember a list similar to that used in Study I.

It was reasoned that as long as a child can sort stimuli along one dimension and then completely resort the same stimuli along another dimension that he should be able to use categories to aid the organization of information. It was expected, however, that without such resort skills, subjects would not be able to use categories since their notions of class membership are so restricted.

Subjects

Ninety-three preschool children (aged 3 - 5 years) were pretested. Thirty of these could sort stimuli along one dimension

but failed consistently to resort along a second dimension. Thirty of these could both sort and resort stimuli consistently. The remaining 33 subjects were excluded either because they evidence class inclusion or because they were not consistent in their responses. The sixty experimental subjects were from a white, residential area. The two groups elected for the memory task did not differ with respect to age (sort and resort $\bar{X}$=57.6 months, sort only $\bar{X}$=60 months).

Classification Pretest

The classification pretest was adapted from Kofsky (1966). Subjects were given 9 blocks (four blue squares, three red triangles and three blue squares) and told to choose a block and put it in a box along with all the others that were like it. Another box was then offered until all the blocks had been sorted into boxes. Kofsky (1966) labels this an Exhaustive Sort. Upon completeing an Exhaustive Sort, subjects were asked to sort all the blocks a different way and to tell what attribute of the blocks was used for each sort.

Following Kofsky's criteria for Horizontal Reclassification (1966) a subject had to successfully sort the blocks completely by color and then completely by shape. Subjects who could exhaustively sort but not reclassify were placed in the sort only group (S). Subjects who successfully reclassified were placed in the sort-resort group (SR).

Memory Task

The memory task was simply a shortened version of the task used in Study I. A total of 15 slides representing the five

animals, five pieces of furniture, and five parts of the body were presented. In all other respects, number of trials, method of cueing, mode of presentation, etc., the memory task was identical to the one detailed in Study I.

Results

The taped recalls of the children were analyzed both for clustering of items and for the total number of items recalled. A 2 (classifier type) by 2 (recall condition) by 3 (trials) repeated measures analysis of variance of the item clustering index indicated that the main effect of classification skill was not significant $F(1,56)=.55$, $p>.05$. However, the amount of classification did increase significantly across the three trials $F(2,112)=4.94$, $p<.01$. More importantly the main effect of the recall situation was significant $F(1,56)=7.53$, $p<.01$.

In contrast to the results of the first study neither of the groups that were in the free recall situation organized the items spontaneously (see Figure 2). The groups that showed increased clustering over trials were the ones that were supplied with cues. Further analysis indicated that in both the second and third trials the cued groups were clustering significantly more than the free recall groups ($F(1,56)=9.05$, $p<.01$; and $F(1,56)=5.02$, $p<.03$ for the second and third trials respectively).

The analysis of the number recalled indicated that only the trials main effect was significant $F(2,112)=12.11$, $p<.01$. Neither the level of classification skill $F(1,56)=.76$, $p>.05$ nor the presence or absence of cues $F(1,56)=3.81$, $p>.05$ had any significant effect on the number of items recalled (see Figure 2).

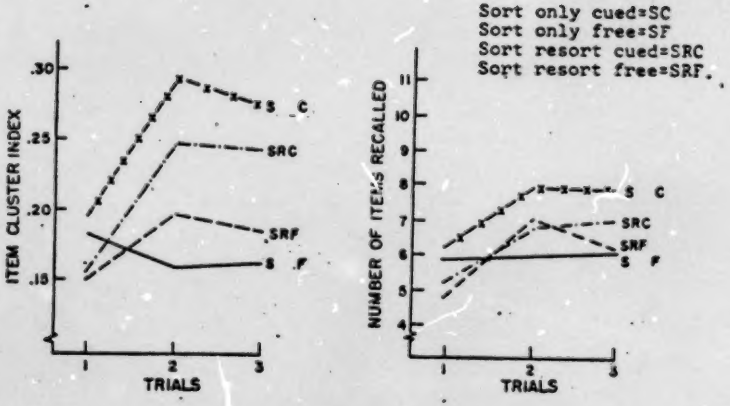

Figure 2

Item clustering index and number of items recalled for all groups of preschoolers

Hence, although the cued groups organized more, this organization did not lead to more items recalled even on the third trial ($F(1,56)=3.73$, p .05).

Discussion

In both studies it was found that even children with very limited classification skills could use cues to help them organize their memory. However, this ability to organize was not accompanied by a greater number of items recalled. Only in the case of children who evidence class inclusion and hierarchical classification was the increase in clustering across trials accompanied by an increase in the number of items recalled. Recently Kreutzer, Leonard, and Falvell (1975) have suggested that in the first stage of remem-

bering items a child fails to notice the categories. In the second stage, the child notices that items can be grouped into common categories; yet fails to exploit this for memonic purposes. In the third stage, the categories are utilized for both storage and retrieval. In the present studies all three of these phases were evident. Of particular interest, in comparison to adult studies, is the finding that more organization in the recalls of young children does not lead to more items recalled. It is as if the organization is a pseudo-organization and is not effective as a memory strategy until class inclusion skills are evidenced.

The results of the present study suggest that the operations of class inclusion and hierarchical classification are at least correlated with the transition to efficient use of organization skills in memory. It may be that the acquisition of these classification skills signals the beginning of the spontaneous organization which is so useful to adults in storing and retrieving information.

It is interesting that young children who cannot even resort objects into a second category can organize their recall if they are given cues. Although this was contrary to the hypothesis, in retrospect it seems sensible to assume that the acquisition of verbal labels is a classification of some sort and that the expansion of these labels into multi-level classification systems is amenable to cues from the external environment.

In conclusion, while adult studies of memory have begun to equate organization and memory, it seems that the acquisition and

utility of this organization ability follows a developmental sequence which can be related to the acquisition of other logical operations. It can also be supposed, from the present studies, that activities which require the child to attend to the properties and classes of objects may help him organize his information. And while organizing per se doesn't guarantee better recall, it could well be that these organizing skills ultimately result in the attainment of class inclusion abilities.

In this light the time that perschool, kindergarten and first grade teachers spend attending to classes and subclasses like days of the week, months of the year, etc., takes on a special significance. This kind of category cueing from teachers and parents could well serve as a model for how to organize information which the child can understand and gradually incorporate into general operational strategies.

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